

# The McMaster-MSU JAVA-NDS program

## 1. What is JAVA-NDS?

It is a program in JAVA language to produce a reader-friendly (or publish-ready) PDF output from an ENSDF-format input file. It converts an ENSDF file to a LaTeX file, from which a PDF output is produced using a LaTeX compiler.

## 2. System requirements and prerequisites:

--- 8G RAM memory for running the program smoothly for large ENSDF mass-chain files. If RAM is less than 8G, code will be quite slow, for example about 2-3 minutes with 8GB, 10 min with 6 GB, and >15 min for 4 GB.

--- latest version of Java:

**JRE 8** or above, which can be downloaded at <http://java.com/en/download/>

--- LaTeX compiler:

for Windows, **MiKTeX**, free to download at <http://miktex.org/download>

[Download MiKTeX 64-bit \(or 32-bit\) version appropriate to your computer.](#)

for Linux and MacOS, a LaTeX compiler should come with the system.

Recommended cross-platform LaTeX editor: **Texmaker**, free to download at

<http://www.xmlmath.net/texmaker/download.html>

### 3, How to run and use JAVA-NDS?

#### **To run JAVA-NDS program:**

Download the code in .zip format and unzip the files.

In Windows:

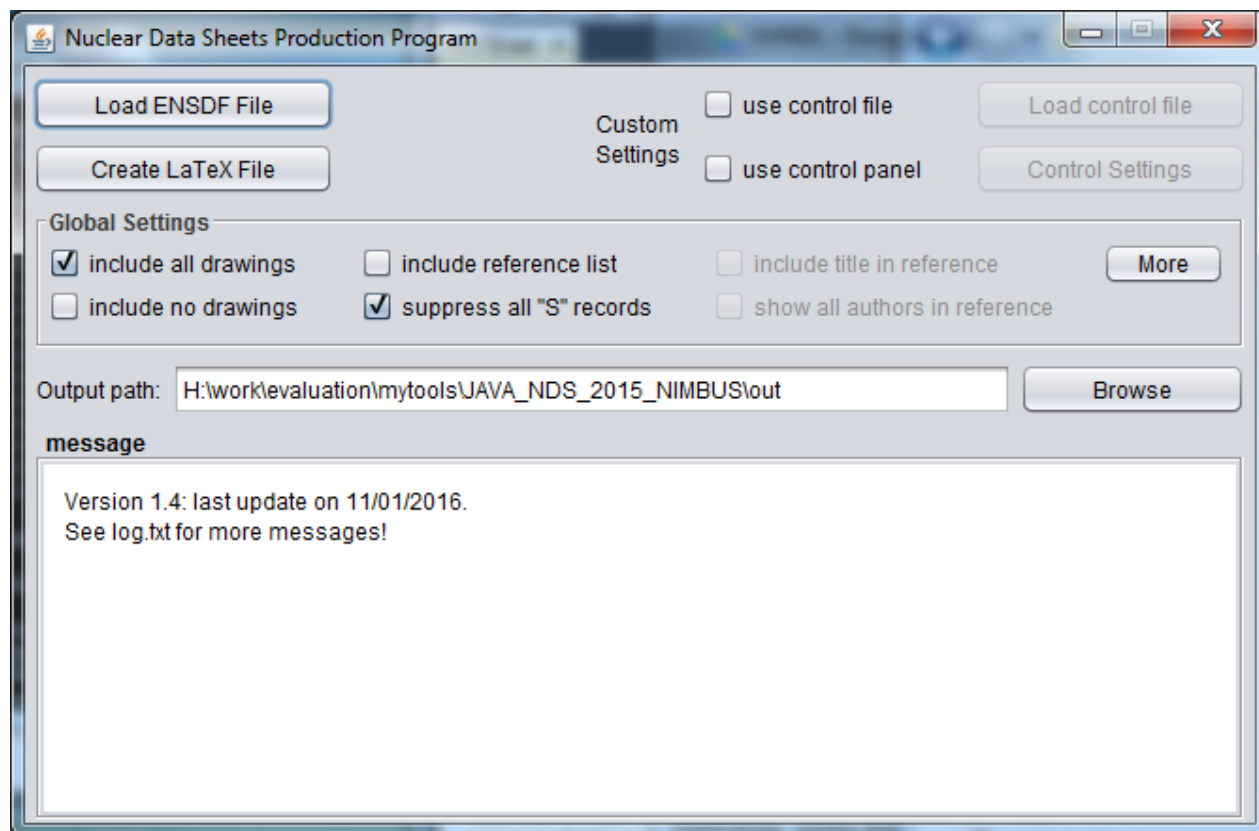
double-click the executable ".jar" file;

In Linux and MacOS:

open a terminal and type,

*"java -jar PATH\_TO\_THE\_JAR\_FILE"*

A window titled as "Nuclear Data Sheets Production Program" will open, as shown below.



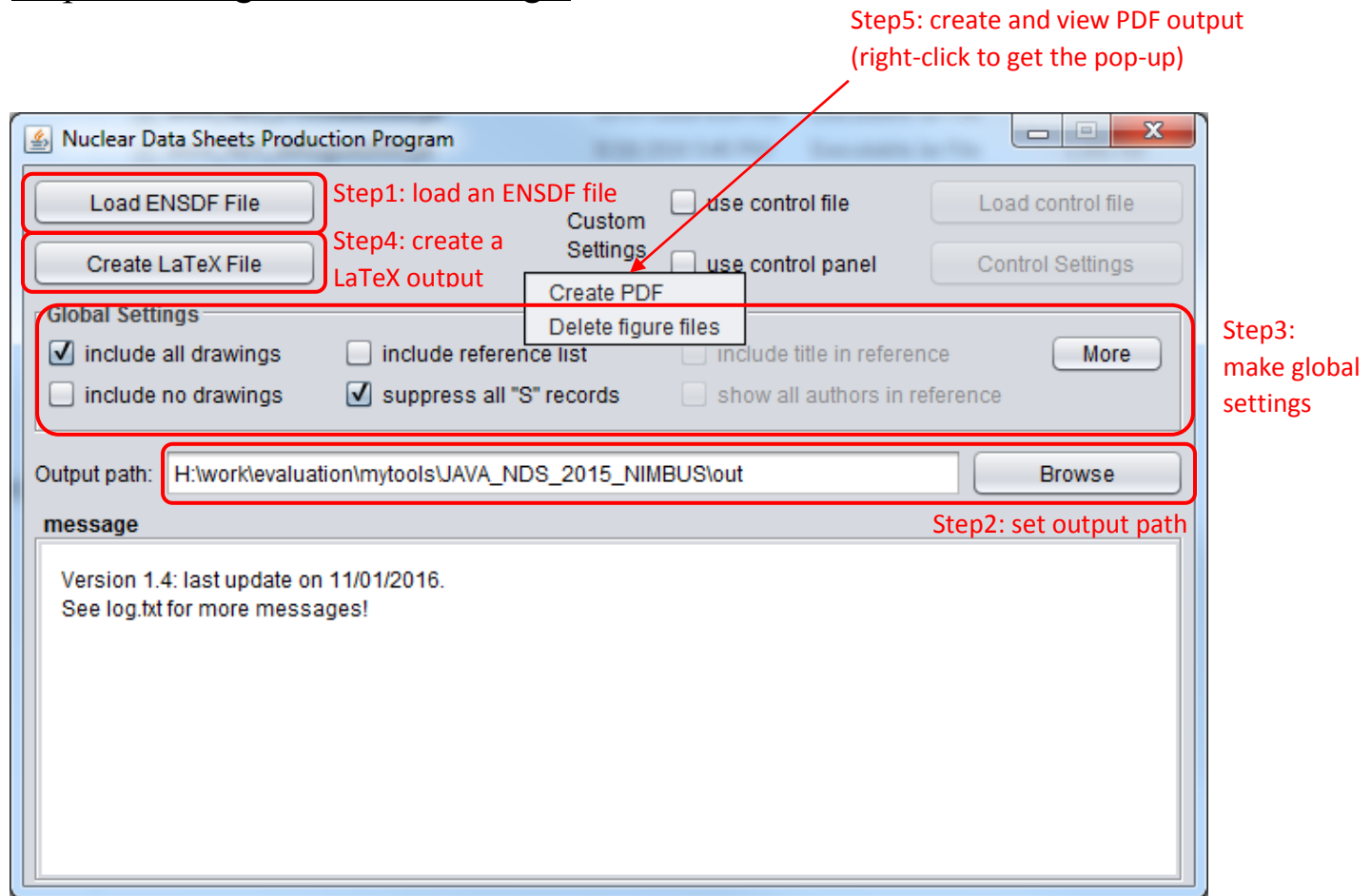
(main GUI window of JAVA-NDS)

**To use JAVA-NDS program:**

The simplest way is to run JAVA-NDS in auto-mode in which the layouts of tables and figures in the output PDF file are automatically adjusted and no custom settings are needed. Further fine adjustments or manual settings can be made either by loading a control file containing custom settings that are written in specific formats, or by using a graphical control panel containing all settings, which are simply clicked to set.

**NOTE: please check the input file against format errors using the FMTCHK checking program before running JAVA-NDS, otherwise the content in the input file could be read and printed incorrectly if there are format errors.**

## Steps for using automatic settings:



Step 1: Click "Load ENSDF File" button to load an ENSDF file.

Step 2: Choose a directory for the output files by typing in the "output path" field or browsing. Skip this step if using the existing path.

Step 3: Make global settings in the "Global Settings" panel. For example, click "Include reference list" button to include the references in the file. Skip this step if using default global settings, as indicated in the "Global Settings" panel after an ENSDF file is loaded.

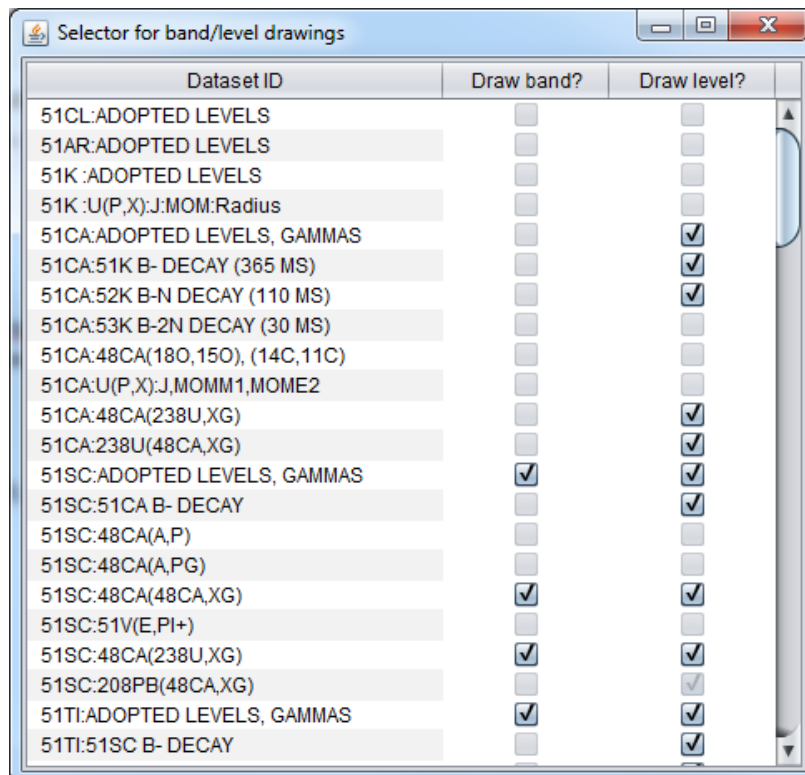
For more settings, click on "More" button. In the pop-up window, selecting drawings to be drawn for each dataset can be made in the "Drawings Selector".

Step 4: Click "Create LaTeX File" button to create a LaTeX file from the input ENSDF file with automatic settings. A script file ("**NDS.dat**" for Windows system; "**NDS.sh**" for Linux and MacOS) is also generated which is to be run to produce a PDF file from the created LaTeX file.

Step 5: Right-click on the blank area to get a small pop-up menu and click "Create PDF" to produce a PDF file from the LaTeX file (this runs the script file generated in previous step in the background). Alternatively, one can double-click the "Create LaTeX File" button in previous step to create the PDF output. In case it does not work either way, one can run the script file manually. To do that in Windows system, in the output folder, look for "**NDS.dat**" script file and double-click it to produce a PDF file from the LaTeX file. (for Linux and MacOS, run "**NDS.sh**" from command line). Click "Delete figures files" in the pop-up menu to clean up all figure files in the output folder if they are not needed.

### Selecting drawings to be shown in output:

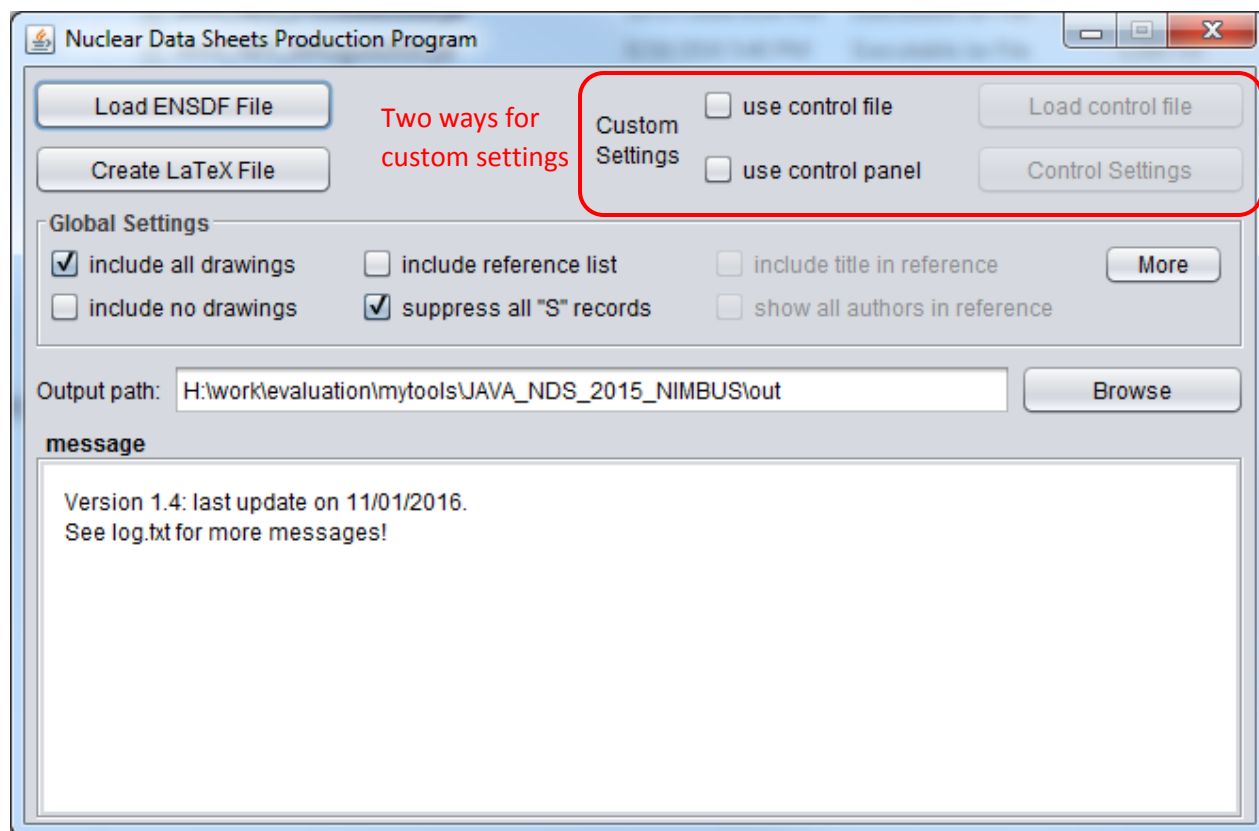
Settings for showing drawings (level and band drawings) can be made in the "Control Settings" panel for each dataset. Alternatively, for quick settings, a "Drawings Selector" is available in the "Global Settings" panel after clicking on "More" button.



## Steps for using custom settings:

Same steps as above for using automatic settings, except for that in step3 (before clicking on “Create LaTeX File” button) custom settings are made using one of the following two ways:

- 1) By loading a control file containing custom settings that are written in specific formats;
- 2) By using a graphical control panel containing all settings, which are simply clicked to set.



## Two ways for custom settings:

### 1) Using a control file

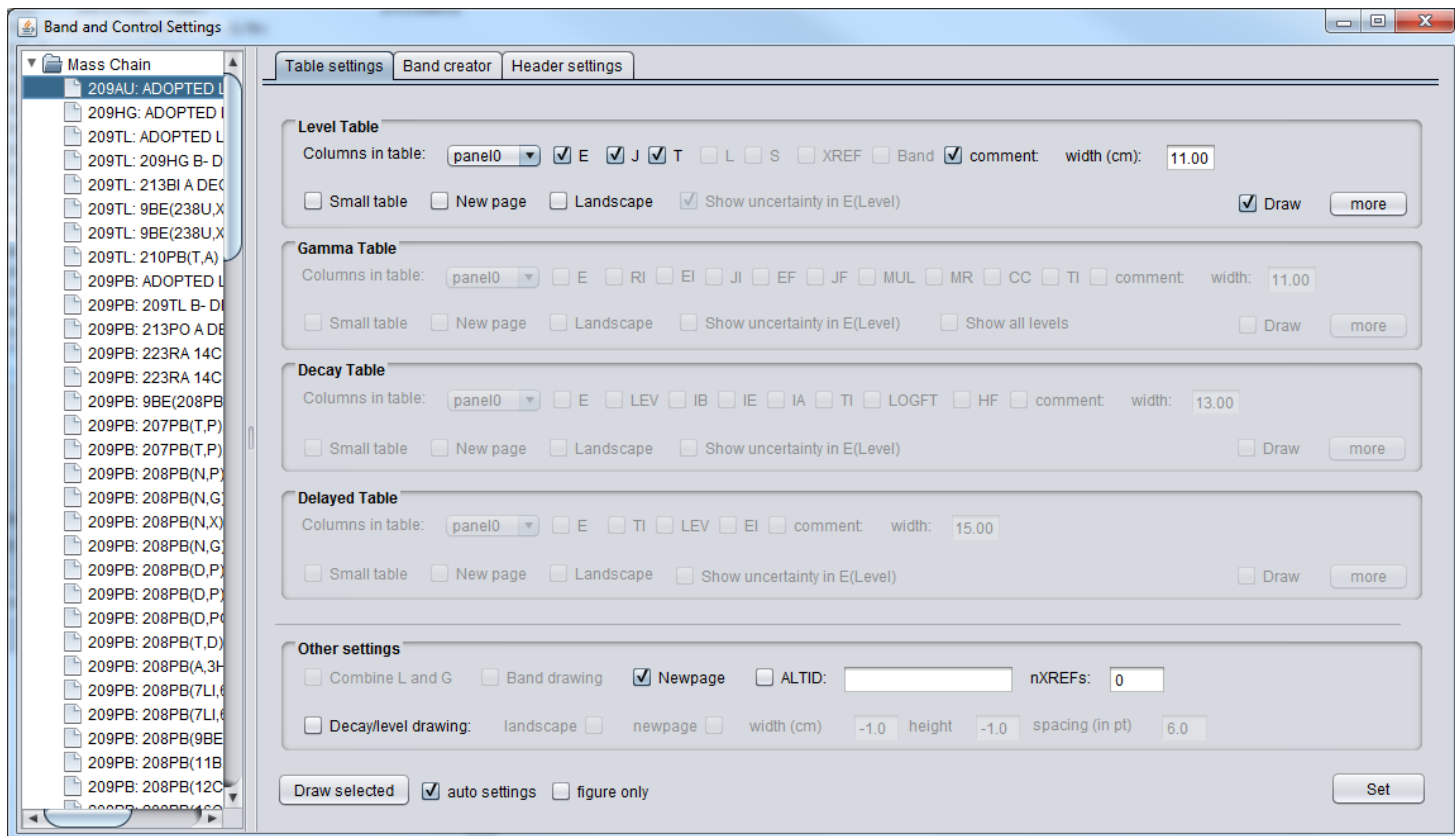
Check the “use control file” box and click on “Load control file” to load a control file with custom settings. Shown below is the screenshot of a part of an example control file. For how to read and make a control file, refer to the instruction in Appendix.

```
REVIEW
ABSTRACT/V:xx/Y:****/R:****
SKELETON/P:1/W:2.1/S:0.5/T:1.5/X:17.71898/Y:17.708
INDEX/B:
  15BE      ADOPTED LEVELS
LEVEL/D:E,J,T,XREF,COMM/W:11.3/M:
PAGE
XREF 2
  15BE      2H(14BE,15BE)                2013SN02
LEVEL/D:E,J,T,COMM/W:12.5/M:
XREF 0
  15BE      9BE(17C,15BE2P)              2011SP01
XREF 0
  15B       ADOPTED LEVELS                1991AJ01          91NP      200204
LEVEL/D:E,T,COMM/W:14.6/M:
PAGE
XREF 0
  15C       ADOPTED LEVELS, GAMMAS        1991AJ01          91NP      200204
LEVEL/D:E,J,T,XREF,COMM/W:8.5/M:
GAMMA/D:LEV,JI,E,RI,LEVF,JF,M,COMM/W:10.0/E:/P:/M:
DRAW/M:6.0/N:1
PAGE
REORDER
XREF 7
```

### 2) Using the control panel

Check the “use control panel” box and click on “Control Settings” button to launch the control-settings panel in which one can view and adjust all settings for tables (“Table settings” sub-panel) and drawings including band drawings (“Band creator” sub-panel) for each data set as well as settings for abstract and skeleton pages (“Header settings” sub-panel). In the control panel, there are options to generate and view output only for selected data set or only for figures (level scheme and band drawings) or only for band drawings. See the following for more details.

## Control-Settings panel:



Launched by clicking on the “Control Settings” button in the main window.

It has three tabbed sub-panels: “Table settings”, “Band creator” and “Header settings”.

Once a data set is selected from the list of data sets in the left side-panel, the current settings for that dataset are reflected in the “Table settings” tabbed panel for all available tables and in the “Band creator” tabbed panel for all available bands.

### “Table settings” tabbed panel:

One can adjust those settings, for example, uncheck a box in “Columns in table” to remove a column from the corresponding table in the output file. Once all adjustments are done, click the “Set” button to apply the changes.



To generate and view the output for the selected data set only, double-click the “Draw selected” button. If “auto settings” is checked, the custom setting will not be used; if “figure only” is checked, only figures will be generated in the output.

The 'Level Table' dialog box contains the following elements:

- Columns in table:** A dropdown menu set to 'panel0' and a series of checkboxes for columns: E (checked), J (checked), T (checked), L (unchecked), S (unchecked), XREF (unchecked), Band (unchecked), and comment (checked).
- width (cm):** A text input field containing '11.00'.
- Options:** Checkboxes for 'Small table' (unchecked), 'New page' (unchecked), 'Landscape' (unchecked), and 'Show uncertainty in E(Level)' (checked).
- Buttons:** A 'Draw' button with a checkmark and a 'more' button.

“**Columns in table**”: columns of data to be displayed in the corresponding table in the output. For long tables that have multiple panels (one in each page), settings can be made for each panel. Uncheck a box to remove the corresponding column from the output table. Disabled columns means such column of data are not available in selected data set.

“**width**”: width of the comment column in the output.

“**Small table**”: check it if the table is small enough to be put in one page.

“**New page**”: check it if the table is to be put in a new page.

“**Landscape**”: check it if the table is to be displayed in landscape orientation.

“**Draw**”: check it if the table is to be displayed in the output.

“**more**” button: click it to launch more table settings, see below.

The 'More settings for level table control' dialog box contains the following elements:

- Data as comment:** Checkboxes for E, J, T, L, and S.
- Print row if contain any:** Checkboxes for E, J, T, L, S, and XREF.
- Put footnotes in a new column:** A checkbox.
- Break points (level energies), check the box if starting a new page:** A section with a grid of 15 rows and 3 columns. Each row has a checkbox, a text input field, and two buttons labeled 'S' and 'R'. Below this grid is a note: "(S - suppress columns after a break point, R - restore previously suppressed columns)".
- Buttons:** 'Cancel' and 'OK' buttons at the bottom.

“**Data as comment**”: put selected column of data in comments.

“**Print row if contain any**”: print the table row if only it contains any of the selected columns.

“**Put footnotes in a new column**”: put footnotes in a table column instead of at the end of table.

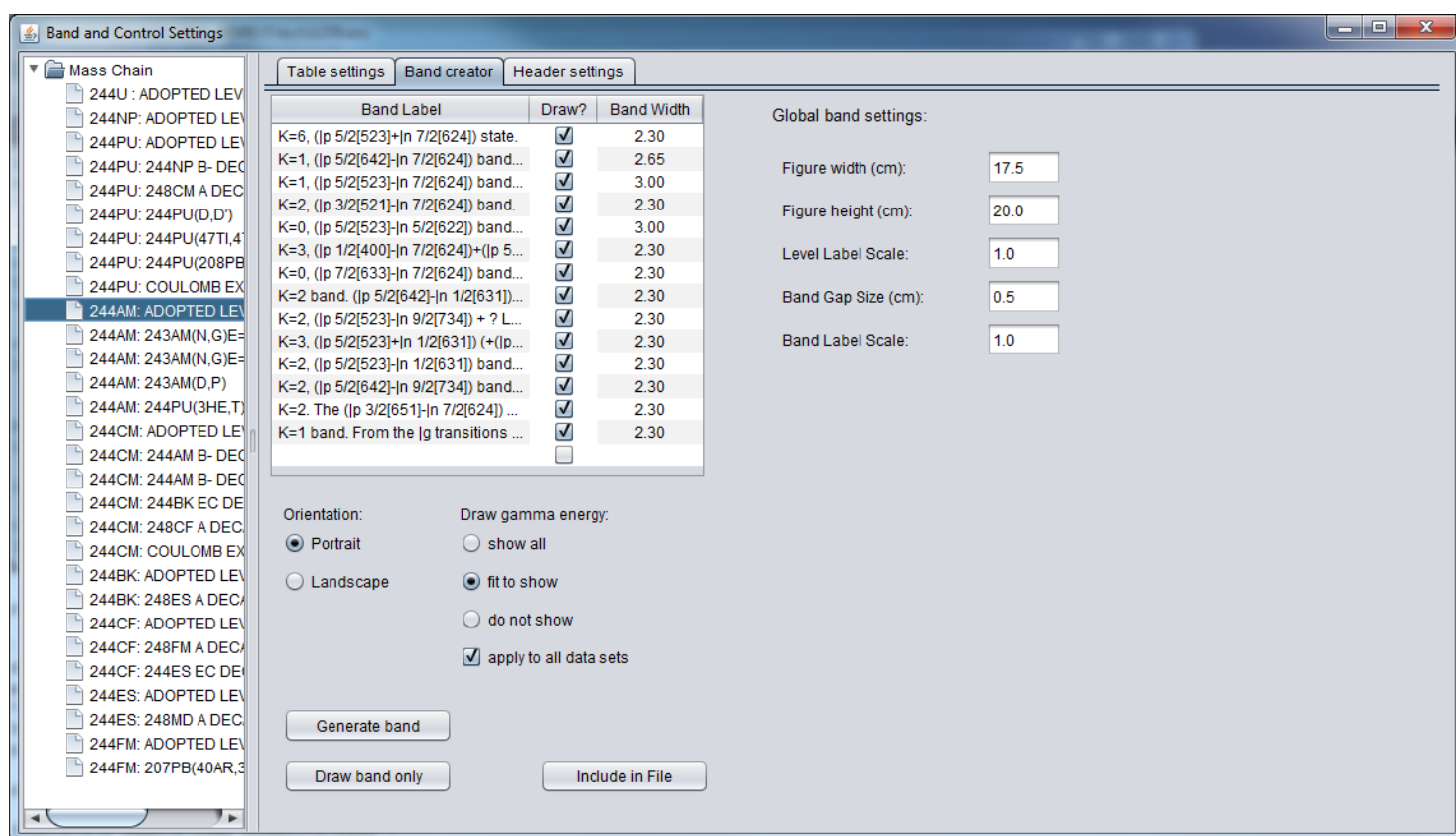
“**Break points**” fields: set points at which (before the point) the table breaks:

- start a new sub-table side-by-side if the box after the break-point value is not checked;
- start a new page if the box is checked.

“**S**” and “**R**” buttons: click to get a pop-up menu in which one can select to suppress columns or restore suppressed columns after the corresponding break point.

Click “**OK**” button to apply the settings.

“Band creator” tabbed panel:



“**Orientation**”: display the band drawing in “**Portrait**” or “**Landscape**” orientation.

“**Draw gamma energy**”:

“**show all**”: show energy labels for all gamma transitions in the bands.

“**fit to show**”: show only energy labels where there is enough room and no overlap.

“**do not show**”: do not show energy labels.

“**apply to all data sets**”: if not checked, the setting is only applied to selected dataset.

“**Generate band**” button: generate band drawings (LaTeX) for the selected dataset only.

“**Include in File**” button: click to include the generated band drawings in the output file.

“**Draw band only**” button: generate and view band drawings only for the selected dataset.

“**Global band settings**” fields:

“**Figure width**” and “**Figure height**”: width & height of the figure of band drawings in cm.

“**Band Gap Size**”: gaps between bands.

“**Band Label Scale**”: scale factor for the font size of the band title.

“**Level Label Scale**”: scale factor for the font size of the level labels.

“Header settings” tabbed panel:

Band and Control Settings

Table settings Band creator Header settings

Output type: ☒ Review ☐ Publication

**Include in output**

☒ Abstract: Vol.  Year  Page  Z (if only one nucleus)

Received date (eg., 24 June 2015)  Revised date

☒ Index ☒ blank page ☐ Reference ☐ mass list

☒ Skeleton: ☐ landscape ☐ ladder width (cm)  spacing  parent spacing

summary table location (bottom-right): on page#  X  Y  page-break ladder index

**Other settings**

Editor's Note for update data sets (on cover page):

Editor's Note for update data sets (on XREF table):

Draw header only Set

“**Abstract**” box: check it to make settings for abstract page.

“**Index**” box: check it to include the index page.

“**blank page**” box: check it to add a blank page after index page.

“**Skeleton**” box: check it to make settings for the skeleton page.

“**landscape**”: check it to put the skeleton in landscape mode.

**“ladder width”**: width of the ladder of each nucleus in the skeleton.

**“spacing”**: gap in cm between ladders.

**“parent spacing”**: vertical gap between parents of a nucleus in the skeleton.

**“on page#”**: index of the page where to put the summary table among skeleton pages.

**“X” & “Y”**: x and y coordinates of the bottom-right corner of the summary table in the page. Note the zero point (0,0) is at the bottom-left of the page.

**“page-break ladder index”**: index of the ladders at which the page breaks (the ladder starts a new page).

**“Draw header only”** button: double-click it to generate and view the header only.

Click on “Set” button to apply the changes.

#### 4. New features in ENSDF format introduced by JAVA-NDS

##### **Local dictionary using “DICT”:**

The JAVA-NDS has an internal global dictionary which contains translations for a large amount of reaction names, nuclide names, and ENSDF keywords in upper-case “C” comments, DSID, or continuation records. But there are names or words in some cases for which there are no translations in the global dictionary, resulting in them printed in the output not as expected. For example, in the following DSID line of a data set,

```
“ 27P   PB(27P,P26SI):XUNDL-5      2016MA26      ”
```

the reaction name “PB(27P,P26SI)” is not in the internal dictionary and thus is printed as is. To resolve this issue, instead of expanding the internal dictionary which needs updating and recompiling the program that is not accessible to users and lacks of flexibility, a local dictionary using “DICT” command which the users can define and control on their own is introduced in JAVA-NDS. For the above example, add the following line anywhere in the top comment section before data records.

```
“ 27P c DICT$PB(27P,P26SI)=Pb({+27}P,p{+26}Si)”
```

This adds a translation “PB(27P,P26SI)=Pb({+27}P,p{+26}Si)” to the local dictionary which only applies in the dataset where the translation is defined and tells the program to convert “PB(27P,P26SI)” wherever in DSID or other places like upper-case “C” comments to “Pb({+27}P,p{+26}Si)” that can be correctly recognized and printed.

Here is the format for defining a translation in the local dictionary:

**“DICT\$word\_in\_uppercase=translation\_in\_lowercase”**

Put it in a new general comment line, as shown in the example above. The type of the new comment line doesn’t matter, as long as it has “c” or “C” at column 7.

Note that the local dictionary works not just for words in DSID but also for words in all uppercase comments or continuation records in the whole data set and the local dictionary takes no effect outside of the data set in which it is defined.

### Particle-unbound levels in beta-decay datasets:

For a decay that has decay branches to particle-unbound levels in daughter nucleus, it is useful as well as for completeness to include information for these levels in data tables and decay scheme in the output. A fake level representing a range of the unbound levels is introduced into the ENSDF file by JAVA-NDS to account for the total decay branches to these levels. This fake level is placed at the end of the data set with the energy record of “SN+X” for neutron-unbound levels and “SP+X” for proton unbound levels, where “SN” and “SP” represents neutron and proton separation energies, respectively. To distinguish it from the real levels and to indicate it is for a range of levels for plotting purpose, a mark “R” representing “Range” is inserted at column 78 of this level-record line. Below is an example, from the data set of “79ZN B- DECAY (0.746 S)”.

In the ENSDF file (only the end part is shown below):

```
79GA  G 1941.4    4    12.9  20                                C
79GA  L 2741.3    3
79GA  B          13    3          5.3    1                                C
79GAS B EAV=2912.1 15
79GA  CB E$5900 80 from B(1778G). Other: 6200 90 from B(2034G)
79GA  G 1778.5    4    30    6                                C
79GA  G 2034.2    5    17    4                                C
79GA  L 2919.7    4
79GA  B          5.6    7          5.58    6                                C
79GAS B EAV=2825.4 15
79GA  CB E$5900 40 from BG coin
79GA  G 358.2     2    18.1  20                                C
79GA  L 2977.7    4
79GA  B          4.7    4          5.64    5
79GAS B EAV=2797.2 15
79GA  G 236.2     3    6.6   20                                C
79GA  G 415.8     4    8.5   20                                C
79GA  L 3020.1    4
79GA  B          7.4    7          5.43    5                                C
79GAS B EAV=2776.6 15
79GA  CB E$5900 100 from BG coin
79GA  G 1100.6    2    25.4  20                                C
79GA  L 3334.8    5
79GA  B          2.2    5          5.9     1
79GAS B EAV=2623.6 15
79GA  G 773.3     3    7.2   15                                C
79GA  L SN+X                                                R
79GA  cL $S(n) ({+79}Ga)=6913.0 {I27} (2012Wa38)
79GA  B          1.7    5
79GA  CB IB$%B-N=1.7 5 (from 79ZN ^Adopted ^Levels)
```

A fake level accounting for a range of neutron-unbound levels

In the decay scheme:

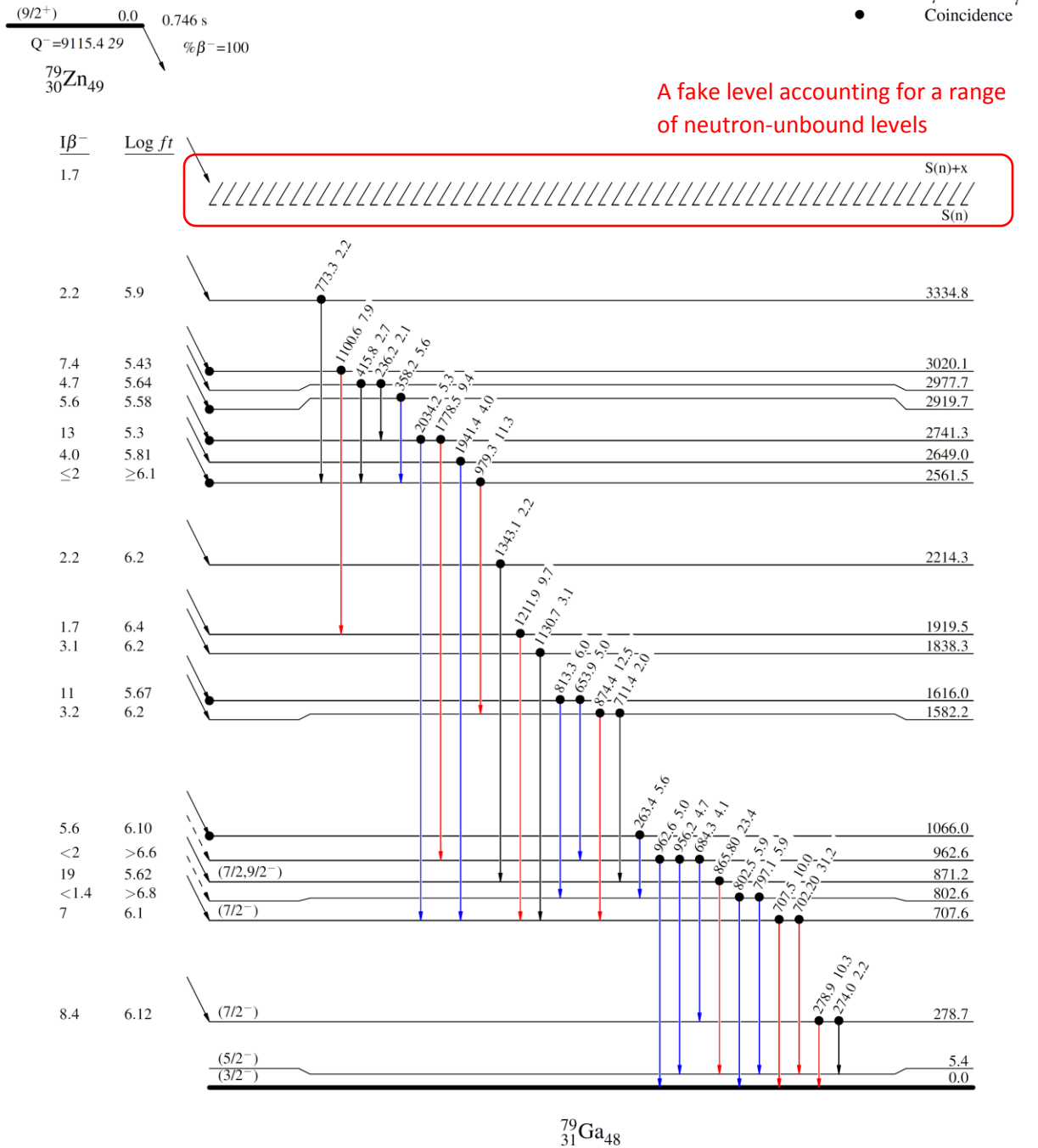
$^{79}\text{Zn}$   $\beta^-$  decay (0.746 s) 1986Ek01

### Decay Scheme

Intensities:  $I(\gamma)$  per 100 parent decays

Legend

- $I_\gamma < 2\% \times I_\gamma^{\max}$
- $I_\gamma < 10\% \times I_\gamma^{\max}$
- $I_\gamma > 10\% \times I_\gamma^{\max}$
- Coincidence



## Appendix:

### Control File:

The Control File is composed of a few commands at the top of the file that relate to the whole data set (the "header"), and then a list of commands following the DSID for each dataset.

Each command consists of a keyword followed by a number of options. The options are given by "/\*:#", where \* is a capital letter that determines the type of option and # is a set of arguments. A basic control file will be generated by the program if it is run without importing a control file.

Example control file:

for Header	REVIEW				
	ABSTRACT/V:xx/Y:****/R:****				
	SKELETON/P:1/W:2.1/S:0.5/T:1.5/X:17.71898/Y:17.708				
	INDEX/B:				
for data sets	15BE	ADOPTED LEVELS	Dataset DSID		
	LEVEL/D:E,J,T,XREF,COMM/W:11.3/M:				
	PAGE				
	XREF 2				
	15BE	2H (14BE, 15BE)	2013SN02		
	LEVEL/D:E,J,T,COMM/W:12.5/M:				
	XREF 0				
	15BE	9BE (17C, 15BE2P)	2011SP01		
	XREF 0				
	15B	ADOPTED LEVELS	1991AJ01	91NP	200204
LEVEL/D:E,T,COMM/W:14.6/M:					
PAGE					
XREF 0					
15C	ADOPTED LEVELS, GAMMAS	1991AJ01	91NP	200204	
LEVEL/D:E,J,T,XREF,COMM/W:8.5/M:					
GAMMA/D:LEV,JI,E,RI,LEVF,JF,M,COMM/W:10.0/E:/P:/M:					
DRAW/M:6.0/N:1					
PAGE					
REORDER					
XREF 7					

An example command in the sample control file above:

**"LEVEL/D:E,J,T,XREF,COMM/W:11.3/M:"**

Explanation:

**LEVEL** --- command keyword. It is for level table in this example.

**/D:E,J,T,XREF,COMM** --- an option for level table. It sets the data columns to be shown in level table in this example.

**/W:11.3** --- option for setting the comment column width=11.3cm in the level table.



Legend for arguments in option commands:

ss: the option takes anything as its argument

xx: the option must take a numerical value

[ ]: this is an optional argument

### Header commands:

Command	Option	Purpose
REVIEW/PUBLICATION		This must be the first line of the file. REVIEW datasets show suppressed continuation records, PUBLICATION datasets do not.
ABSTRACT		Include an Abstract as the first page
	/V:ss	The volume number of the abstract
	/Y:ss	the year of the abstract
	/R:ss	The received date
	/C:ss	revised date (optional)
	/Z:xx	Z number if this is a publication on only one nucleus and not a whole mass chain
INDEX		Include a table of contents
	/B:	include a blank page after the table of contents
REFERENCE		Include a bibliography at the end of the publication
	/A:	A list of masses if this bibliography refers to more than one mass chain
UPDATE		This is an update dataset. A comment will be placed on the abstract page saying that some datasets are not included. Any dataset in an XREF but not included in the control file will generate a comment on the XREF table saying that the dataset is available online
SKELETON		Write a skeleton drawing
	/H:	Print the drawing in landscape mode
	/W:xx	The width of the nucleus ladders in the diagram (in cm)
	/S:xx	The spacing between adjacent ladders (in cm)
	/P:xx	The number of the page to put the summary table on
	/T:xx	The spacing between the nuclei and the parent nuclei drawn above. Increase if they are overlapping(in cm)
	/B:xx[,yy,zz]	the index of bands before which there should be a page break
	/X:xx	x coordinate of the bottom-right corner of the summary table
	/Y:xx	y coordinate of the bottom-right corner of the summary table

## Dataset commands:

Command	Option	Purpose
LEVEL		Write a level table
GAMMA		Write a gamma table
BETA		Write a table of beta-minus decays
ALPHA		Write an alpha table
ELECTRON		Write a table of beta+/EC decays
PARTICLE		Write a table of delayed particles
UNPLACED		Write a table of unplaced gamma rays. The table will share its comments with the GAMMA table, and the unplaced gammas will not appear in the gamma table
Options for all commands above	/D:ss[,tt,uu,...]	The columns to draw in this table, according to the legend given on the following page
	/O:ss[,tt,uu,...]	write the data in these columns as a comment
	/E:	Do not show uncertainties on the level energies
	/P:	This table starts a new page
	/M:	SmallTable option. This is used to fix tables with very few columns (one to three) which are not long enough to be split. The table must not span multiple pages. This command removes certain structures important to spanning pages in order to allow the table to be properly centered. If the table is long enough to span multiple pages, it should be broken up using the {/B:...} command instead
	/A:	Shows all levels (for gamma tables)
	/F:ss[,tt,uu,...]	Print a row of the table only if it contains one of the columns given here. Write a comment at the end of the table indicating which columns were used
	/W:xx	The width of the comments column in this table. Changing this can be a good way to make slight changes to the length of a table.
COMBINE		Write the level and gamma table beside each other
DRAW		Include a decay drawing
	/H:	landscape the decay drawing
	/X:	width of the decay drawing
	/Y:	height of the decay drawing
	/P:	start this drawing on a new page. To get a drawing at the top of the page with the next dataset below it, add this option.
PAGE		option from the following dataset.
	/M:	Minimum spacing (in pt) between levels in the drawing
ALTIDsss		Replace the old DSId of the dataset with the one given
PAGE		This dataset starts a new page
REORDER		sort the gamma ray table by level energy, not gamma energy
XREFxxx		The number of Xrefs to include in adopted levels tables

The following options LEVEL,GAMMA,BETA,ALPHA,ELECTRON,PARTICLE and UNPLACED commands must be enclosed in {brackets}. Each set of brackets can contain one, and only one, /B: option

Option	Purpose
/B:xx[,yy,zz...]	All entries greater than xx should be given in a new column. The number compared to xx is the number the table is sorted by.
/B:F	The footnotes for this dataset should be in a new column beside the table
/S:ss[,tt,uu,...]	Suppress these columns for the rest of the table
/R:ss[,tt,uu,...]	Restore previously suppressed columns
/N:	This break also begins a new page

Explanations of column names used in option arguments:

Column name	Description
E	Energy (all)
LEV	Level (Gamma, Decay and Delayed Particle)
LEVf	Final Level (Gamma)
J	Spin and Parity (Level)
Ji	Initial Spin and Parity (Gamma)
Jf	Final Spin and Parity (Gamma)
BND	Band (Level)
XREF	XRefs (Level)
T	Half-life (Level)
L	Angular Momentum (Level)
S	Spectroscopic Strength (Level)
RI	Relative Intensities (Gamma,Delayed Particle)
M	Multipolarity (Gamma)
MR	Mixing Ratio (Gamma)
CC	Conversion Coe
TI	cient (Gamma)
IB,IA,IE,IP	Total Intensity (Gamma, Decay)
LOGFT	Decay Intensity (Decay)
HF	Logft (Decay)
EI	Hinderance Factor (Decay)
COMM	Intermediate Level Energy (Delayed Particle)